

FORM PTO-1390 (Modified)
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U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371

KSN0024

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR

10/049950

INTERNATIONAL APPLICATION NO.
PCT/DE00/02842INTERNATIONAL FILING DATE
18 August 2000PRIORITY DATE CLAIMED
20 August 1999

TITLE OF INVENTION

ELECTRICAL CONNECTOR

APPLICANT(S) FOR DO/EO/US

Helge Schmidt and Reinhard Sander

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (24) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
 - a. ☐ is attached hereto (required only if not communicated by the International Bureau).
 - b. ☒ has been communicated by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
 - a. ☒ is attached hereto.
 - b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
 - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
 - b. ☐ have been communicated by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☐ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☒ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☒ Certificate of Mailing by Express Mail
23. ☒ Other items or information:

Check No. 100464

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 1.101) 10,049,950		INTERNATIONAL APPLICATION NO. PCT/DE00/02842		ATTORNEY'S DOCKET NUMBER KSN0024	
24. The following fees are submitted:.				CALCULATIONS PTO USE ONLY	
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :					
<input type="checkbox"/> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO				\$1040.00	
<input checked="" type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO				\$890.00	
<input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO				\$740.00	
<input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)				\$710.00	
<input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)				\$100.00	
ENTER APPROPRIATE BASIC FEE AMOUNT =				\$890.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).				\$0.00	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	27 - 20 =	7	x \$18.00	\$126.00	
Independent claims	1 - 3 =	0	x \$84.00	\$0.00	
Multiple Dependent Claims (check if applicable).			<input type="checkbox"/>	\$0.00	
TOTAL OF ABOVE CALCULATIONS =				\$1,016.00	
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2.				\$0.00	
SUBTOTAL =				\$1,016.00	
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492 (f)).				\$0.00	
TOTAL NATIONAL FEE =				\$1,016.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable).			<input type="checkbox"/>	\$0.00	
TOTAL FEES ENCLOSED =				\$1,016.00	
				Amount to be refunded	\$
				charged	\$
a. <input checked="" type="checkbox"/> A check in the amount of \$1,016.00 to cover the above fees is enclosed.					
b. <input type="checkbox"/> Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.					
c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 02-0387 A duplicate copy of this sheet is enclosed.					
d. <input type="checkbox"/> Fees are to be charged to a credit card. WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.					
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.					
SEND ALL CORRESPONDENCE TO:					
Eric J. Groen Baker & Daniels 205 West Jefferson Blvd. Suite 250 South Bend, IN 46601			[Signature] SIGNATURE Eric J. Groen NAME 32,230 REGISTRATION NUMBER February 19, 2002 DATE		
Telephone: 574-234-4149 Fax: 574-239-1900					

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IC10 Rec'd PCT/PTO 19 FEB 2002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Helge Schmidt and Reinhard Sander

Filed: PCT/DE00/02842 (August 18, 2000)

Serial No.:

Title: ELECTRICAL CONNECTOR

Group/Art Unit:

Examiner:

Docket No.: KSN0024

Honorable Commissioner for Patents
Washington, D.C. 20231

Sir:

PRELIMINARY AMENDMENT

In the above-mentioned PCT application, please accept the enclosed application under the national stage pursuant to 35 USC § 371 and amend the application as follows:

In the Claims:

Please replace claims 1-27 of the application with claims 1-27 as follows:

1. An electrical connector comprising a multiplicity of contact elements, with the electrical connector containing one or more connector modules, each thereof comprising at least one contact support and a multiplicity of contact elements connected to the contact support and extending along the surface thereof, the contact supports and the contact elements being supported by the same are connected to each other in non-releasable manner.

2. An electrical connector according to claim 1, wherein the contact elements are constituted by metal strips.

3. An electrical connector according to claim 1, wherein the front ends of the contact supports are portions thereof without contact elements.

4. An electrical connector according to claim 3, wherein the front ends of the contact supports are provided with tapers suitable for centering with respect to other contact elements.

5. An electrical connector according to claim 1, wherein the contact elements project beyond the rear end of the contact supports.

6. An electrical connector according to claim 5, wherein the contact elements have a bent or kinked section in the portion thereof extending beyond the rear end of the contact supports.

7. An electrical connector according to claim 6, wherein the bent or kinked sections of the contact elements in the assembled state of the electrical connector, come to lie in a cavity contained in said connector.

8. An electrical connector according to claim 7, wherein the contact element parts located on either side of the bent or kinked sections are movable relative to each other also in the assembled state of the electrical connector.

9. An electrical connector according to claim 1, wherein the contact elements, in the region in which they are supposed to establish contact with an associated contact element, have one or more protuberances or bulges acting as contact locations.

10. An electrical connector according to claim 9, wherein the portions of the contact elements having said protuberances or bulges are designed to be resilient.

11. An electrical connector according to claim 1, wherein the contact elements are connected to the contact supports by having plastics material injection-molded around part thereof.

12. An electrical connector according to claim 1, wherein the contact supports have groove-like recesses at those locations where contact elements are to be provided thereon.

13. An electrical connector according to claim 12, wherein the contact elements are inserted into the groove-like recesses of the contact supports and, at the rear end of the contact supports, are connected to the contact support in that plastics material is injection-molded thereto.

14. An electrical connector according to claim 12, wherein the contact elements are designed and mounted to the contact supports such that the parts thereof extending through the groove-like recesses, which are not injection-molded to the contact supports, are resiliently urged against the bottom of the groove-like recess through which they extend.

15. An electrical connector according to claim 1, wherein the contact support is injection-molded to the contact elements.

16. An electrical connector according to claim 1, wherein the assembled state of the electrical connector, a predetermined section of the connector modules is inserted between other components of the electrical connector and thereby is held there.

17. An electrical connector according to claim 16, wherein said predetermined section of the connector modules and the other components of the electrical connector receiving said section therebetween have spaces provided therebetween.

18. An electrical connector according to claim 1, wherein the connector modules, in the assembled state of the electrical connector, are movable relative to each other and/or relative to other components of the electrical connector.

19. An electrical connector according to claim 1, wherein the connector modules are individually or commonly enclosed on the sides thereof by parts of a housing.

20. An electrical connector according to claim 19, wherein the housing parts enclosing the connector modules project beyond the front end of the connector modules.

21. An electrical connector according to claim 20, wherein the housing parts projecting beyond the front end of the connector modules are provided with tapers suitable for centering with respect to the housings of other electrical connectors.

22. An electrical connector according to claim 1, characterized in that, in mating the electrical connector with a complementary, second electrical connector, the connector modules meet each other only after having been pre-centered.

23. An electrical connector according to claim 22, wherein the pre-centering is effected by centering of housing parts meeting each other therebefore.

24. An electrical connector according to claim 1, wherein said connector is designed to be soldered to a circuit board using the PSGA technology.

25. An electrical connector according to claim 1, wherein said connector is designed to be soldered to a circuit board using the BGA technology.


26. An electrical connector according to claim 25, wherein the balls are arranged remote from the locations where the contact elements reach the section of the electrical connector to be soldered to the circuit board, and that the respective locations and the associated balls are connected to each other via conductive tracks.

27. An electrical connector according to claim 25, wherein the balls are arranged at the locations where the contact elements reach the section of the electrical connector to be soldered to the circuit board, and in that the arrangement of the respective locations is selected to be different from the arrangement of the contact elements on the contact supports.

REMARKS

Applicant respectfully requests that the above preliminary amendment be entered, and that the fees due herewith are calculated using the new claims, not the claims of the PCT application.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Eric J. Green', written over a horizontal line.

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(PCT/DE00/02842)

Description5 **Electrical Connector**

The present invention relates to a device according to the generic clause of claim 1, i.e. to an electrical connector comprising a multiplicity of contact elements.

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Electrical connectors have been known for many years in a multitude of forms.

Due to the continuous increase in complexity and efficiency of electronic systems, there are also ever increasing requirements as to the electrical connections between the system components. In this regard, there is an increasing demand of electrical connectors which on the one hand operate reliably under all circumstances, i.e. also under high mechanical and electrical loads, and which on the other hand have as many contacts as possible while being as small as possible.

There are already various electrical connectors known in which attempts have been made of fulfilling the requirements mentioned.

In this context, the electrical connectors should be mentioned that are used for connecting LCD units to the apparatus controlling the same. To this end, there are usually employed electrical connectors having press-on contacts, with the press-on contacts being realized by a very dense arrangement of conductive elastomer portions in a non-conductive elastomer. The connections to be established via such electrical connectors are of rela-

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tively high impedance and moreover necessitate extremely clean conditions.

These problems can be solved at least in part by making
40 use of correspondingly small and multi-position connectors.

Multi-position connectors of miniaturized configuration are known from WO 95/24748 and WO 96/08056. However,
45 connectors of this type are not susceptible of reliable control, both in manufacture and in handling thereof, and the same thus holds analogously for the electrical connections established by such electrical connectors.

50 It is thus the object of the present invention to provide a multi-position miniaturized connector that is capable of reliably establishing electrical connections of high quality.

55 According to the invention, this object is met by the features claimed in the characterizing part of claim 1.

The latter provides that the electrical connector contains one or more connector modules, each thereof comprising at least one contact support and a multiplicity
60 of contact elements connected to said contact support and extending along the surface of the same.

Due to the arrangement of the contact elements along the
65 surface of a contact support, they can be reliably arranged and held in predetermined positions without a problem. In addition thereto, when they are contacted with other contact elements, they have to be capable of withstanding no or just minimum mechanical loads. At any
70 rate, possibly occurring mechanical loads do not entail a change of the contact element position or damage of the contact elements. This holds also for the event that

the contact elements are of weak mechanical design. The contact elements thus can be made very small and/or have
75 a very dense arrangement.

If, for example, very narrow metal strips are used as contact elements and these are connected to the contact support supporting the same, for example, by having
80 plastics material injection-molded thereto, which is possible without any problem with the claimed construction of the electrical connector, a multi-position miniature connector can be provided by means of which electrical connections of high quality can be reliably
85 established.

Advantageous developments of the invention are indicated in the dependent claims, the following description and the drawing figures.

90 In the following, the invention will be described in more detail by way of embodiments with reference to the drawings.

95 In the drawings:

Fig. 1 shows a perspective view of connector modules of the electrical connectors described in more detail hereinafter,

100 Fig. 2 shows a frontal plan view of a connector plug containing a plurality of plug modules according to Fig. 1,

105 Fig. 3 shows a frontal plan view of a connector coupling member containing a plurality of coupling modules according to Fig. 1,

Fig. 4A shows a cross-sectional view of the plug according to Fig. 2,

Fig. 4B shows a cross-sectional view of the coupling member according to Fig. 3,

Fig. 4C shows a cross-sectional view of an assembly in which a plug according to Fig. 2 and a coupling member according to Fig. 3 are mated,

Fig. 5 shows a bottom plan view of a base of the plug according to Fig. 2 or of the coupling member according to Fig. 3, said base being mountable on a circuit board by way of the BGA technology, and

Fig. 6 shows a bottom plan view of a modified base of the plug according to Fig. 2 or of the coupling member according to Fig. 3.

The electrical connectors described hereinafter are circuit board connectors. However, it is to be pointed out already here that there is no restriction thereto. The special features of the electrical connectors described may also be applied to electrical connectors employed for other purposes.

As is usual with pluggable connectors, an electrical connection is established by mating an electrical connector in the form of a plug and an electrical connector in the form of a coupling member.

In the embodiment illustrated, the plug comprises a multiplicity of identical plug modules arranged side by side and/or on top of each other. The same holds for the coupling member. The latter comprises a multiplicity of identical coupling modules arranged side by side and/or

on top of each other. However, the invention is not restricted to this. The plug and the coupling member may also contain only one module or a plurality of not identical modules.

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A plug module and a coupling module are shown in a perspective view in Fig. 1. The plug module is designated SM and the coupling module is designated KM. The plug module SM is adapted to be inserted into the coupling module KM.

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In the embodiment illustrated, each connector module (each plug module and each coupling module) comprises 32 contact elements. However, the number of contact elements may also be arbitrarily higher or lower.

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If a plurality of such plug modules SM is arranged above each other and/or beside each other on a base that is preferably common to all plug modules and if these are enclosed by a common housing, one arrives at the electrical plug described in more detail herein. The front view of such an electrical connector is shown in Fig. 2.

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The same holds for the coupling modules KM in corresponding manner. If a plurality of such coupling modules KM is arranged on top of each other and/or side by side on a base that is preferably common to all coupling modules and if these are enclosed by a common housing, one arrives at the electrical coupling member described in more detail herein. The front view of such an electrical connector is shown in Fig. 3.

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Figs. 4A, 4B and 4C illustrate cross-sectional views of the electrical connectors according to Figs. 2 and 3. To be precise, Fig. 4A shows a cross-sectional view of the plug according to Fig. 2, Fig. 4B shows a cross-sectional view of the coupling member according to Fig. 3,

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and Fig. 4C shows the plug according to Fig. 2 and the coupling member according to Fig. 3 in the mated state.

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The plug illustrated in Fig. 4A comprises a base 1 (already mentioned hereinbefore), a housing 2 (also already mentioned) and one or more plug modules SM, with each plug module SM consisting of a contact support 3 and a multiplicity of contact elements 4.

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In the embodiment shown, there is provided one single contact support 3 for each plug module SM; each contact support 3 has mounted thereon all contact elements of the respective plug modules. However, the invention is not restricted to this design. Basically, there may be an arbitrary number of contact supports provided for each plug module SM.

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As can be seen in particular from Figs. 1 and 2, the contact elements 4 are arranged on the contact support 3 carrying the same in the form of two mutually opposing contact element rows. Although this is presently deemed to be the optimum arrangement, the invention is not restricted thereto.

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In the embodiment shown, the contact elements 4 are constituted by relatively long and relatively narrow metal strips with as high rigidity as possible. In a portion 41 located relatively far to the rear, they have a (preferably multiply) curved or kinked path (e.g. of zig-zag shape). The contact elements 4 of the plug and/or of the coupling member in addition thereto have in the front portion (the portion provided for establishing contact with the contact elements of the coupling member and the plug, respectively) at least one, but preferably two or more bulges or equivalent designs of the contact elements. In the embodiment shown, it is the contact elements 4 of the plug that are provided

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220 with these bulges; these bulges bear the reference numeral 42.

The bent or kinked portion 41 of the contact elements 4 renders possible that the parts of the contact elements
225 located on either side, i.e. both sides of said portion are movable relative to each other. In the properly assembled condition of the electrical connector, portion 41 comes to lie in a cavity 11 of the electrical connector present between base 1 and contact support 3, and
230 thus renders possible that the location of the contact element, and more strictly speaking the location of the plug modules containing the same may still vary and/or be changed to a certain extent with respect to the proper normal position also in the assembled state of
235 the plug, both in the longitudinal direction of the contact elements 4 and in the direction transverse to said longitudinal direction. This turns out to be advantageous both in terms of manufacture of the electrical connector and in terms of use thereof.

240 The bulges 42 (or comparable designs of the contact elements) constitute resilient contact locations via which the contact elements 4 of the plug are contacted with the contact elements of the coupling member. If, as in
245 the embodiment shown, there are provided several contact location establishing bulges or the like on each contact element, the respective contact elements may be contacted at multiple locations with the contact elements to be contacted, and thus are multiple contact elements
250 permitting particularly good and reliable connections to be established with other contact elements.

The contact elements 4 are each arranged so as to extend along the surface of the contact supports 3 carrying
255 them and are held in the proper position on the respec-

tive contact support 3 by having plastics material injection-molded around part thereof.

260 In case of the plug, the contact supports 3 are constituted by rails provided with groove-like recesses 31 at those locations where the contact elements 4 are supposed to come to lie, i.e. on mutually opposing longitudinal sides.

265 In assembling the contact elements 4 on the contact supports 3, the contact elements 4 are inserted into the groove-like recesses 31 and then are fixed to the respective contact support by injection-molding around the rear end of the contact support 3 and the contact element parts located there.

270 The contact elements 4 then are mounted to the contact support 3 such that the front end thereof terminates a distance before the front end of contact support 3 and that the rear end thereof, inclusive of the bent or kinked portion 41, projects beyond the rear end of contact support 3.

280 In the embodiment shown, the portions without injection-molding of the parts of the contact elements arranged in the groove-like recesses 31 of contact support 3 are not attached to the contact support 3. However, the contact elements are designed and injection-molded to the contact supports such that the non-molded portions thereof extending through the groove-like recesses 31 are resiliently urged against the bottom of the recess 31 through which they extend. It is ensured in this manner that the contact elements - although these are each attached to the contact supports at one single location only - cannot or, at any rate, cannot easily leave the groove-like recesses.

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By way of the design and assembly of the contact elements as described hereinbefore, these can be reliably
295 held in their proper position even if they are of very small and/or weak design and/or if they were subjected to mechanical loads.

Due to the afore-mentioned injection molding operation
300 around contact support 3, the latter is provided with a collar 32 at the rear end thereof. This collar, as will still be described in more detail, can be utilized for mounting the contact supports (the plug modules containing the contact supports) within the plug. By way of the
305 afore-described connection of contact support and contact elements, the plug module thus does not become larger than without such a connection.

As regards the contact support 3, it is to be noted further
310 thermore that the same is tapered at the front end thereof (where no contact elements are provided). This serves for centering the mutually associated plug and coupling modules during mating of plug and coupling member.

315 A contact support 3 and the contact elements arranged thereon as just described constitute a plug module SM of the type shown in Fig. 1.

320 A plurality of the plug modules SM that can be configured and made as described hereinbefore can be combined with the afore-mentioned base 1 and the afore-mentioned housing 2 so as to form a plug of the type according to Fig. 2.

325 In the embodiment shown, the base 1 is a plate-like member designed at the top thereof for placement of a plurality of plug modules SM and of the housing 2, and designed at the bottom thereof for soldering the rear ends

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330 of the contact elements 4 to the base 1 and for mounting
the base 1 on a circuit board, not shown in the draw-
ings. The base 1 is formed in its bottom with a multi-
plicity of holes provided for passage of the rear ends
of the contact elements 4. The top side of the base bot-
335 tom is provided in addition with the recesses which, in
the assembled state of the plug, constitute the already
mentioned cavities 11. In assembling the plug modules SM
on the base 1, the rear ends of the contact elements 4
are passed through the holes in the base bottom and are
340 soldered or otherwise electrically and/or mechanically
connected to the base on the bottom side thereof or to
elements provided for connecting the base to the circuit
board. The bent or kinked portions 41 of the contact
elements 4 come to lie in the recesses of base 1 that
345 constitute the cavities 11 of the plug.

In the embodiment illustrated, the housing 2 is a
trough-like structure having a bottom 21 and side walls
22. Bottom 21 is provided with openings through which
350 the forward parts of the plug modules SM can be passed.
The rear ends of the plug modules SM, which carry the
collars 32, cannot pass the openings in the housing bot-
tom. In the assembled state of the plug, the plug module
parts not fitting through the housing bottom openings
355 come to lie between the housing 2 and the base 1, as
shown in exemplary manner in Fig. 4A. Housing 2 is con-
nected to base 1, for example, by an adhesive bond, a
locking-type connection or other connection. Thus, base
1, housing 2 and plug modules SM thus are combined to
360 form an integral unit.

In the assembled state of the plug, as described, the
side walls 22 of housing 2 extend around the portion of
the plug containing the plug modules. These walls proj-
365 ect beyond the front ends of the plug modules.

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The front end of the housing side walls 22 is provided with a taper 23 on the inside thereof. This taper serves for centering plug housing and coupling member housing when plug and coupling member are mated.

In the embodiment illustrated, the coupling member for connection to the plug designed and made as described hereinbefore, is of different construction and manufactured differently than the plug.

As can be seen in particular from Fig. 4B, the coupling member comprises a base 6, a housing 7 and a plurality of coupling modules KM, with each coupling module KM consisting of a contact support 8 and a multiplicity of contact elements 9.

In the embodiment illustrated, there is provided for each coupling module KM one single contact support 8 each; each thereof has mounted thereon all contact elements 9 of the respective coupling modules. However, the invention is not restricted to this design. Basically, it is possible for each coupling module KM to have an arbitrary number of contact supports 8.

As can be seen in particular from Figs. 1 and 3, the contact elements 9 are arranged on their supporting contact support 8 in two mutually opposing contact element rows. Although this is presently deemed to be the optimum arrangement, the invention is not restricted thereto.

In so far, there is conformity with the plug according to Fig. 4A. The individual components of the coupling member, however, are different from the corresponding components of the plug.

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In the embodiment illustrated, the contact elements 9, just like the contact elements 4 of the plug, are constituted by relatively long and relatively narrow metal strips with as high rigidity as possible. In a portion 91 located relatively far to the rear, they have a (preferably multiply) curved or kinked path (e.g. of zig-zag shape), but are otherwise of straight design.

The bent or kinked portion 91 of the contact elements 9 renders possible that the parts of the contact elements 9 located on either side thereof are movable relative to each other. In the properly assembled condition of the electrical connector, portion 91 comes to lie in a cavity 61 of the electrical connector present between base 6 and contact support 8, and thus renders possible that the location of the contact elements 9, and more strictly speaking the location of the coupling modules containing the same may still vary and/or be changed to a certain extent with respect to the proper normal position also in the mated state of the coupling member, both in the longitudinal direction of the contact elements and in the direction transverse to said longitudinal direction. This turns out to be advantageous both in terms of manufacture of the electrical connector and in terms of use thereof.

The contact elements 9 are each arranged so as to extend along the surface of the contact supports 8 carrying the same. In this case, however, the contact support 8 is injection-molded to the contact elements which prior thereto were properly arranged and aligned (and inserted in an injection-molding means). Injection-molding of the contact support 8 to the contact elements 9 means for the contact elements 9 a partial injection-molding of plastics material around the same. Due to this molding operation, the contact elements are attached to the contact support 8 formed by such injection-molding, with

440 such attachment being effected over the entire length of the contact element portions extending along the contact support 8.

In the embodiment illustrated, the contact supports 8
445 are constituted by sleeves of rectangular cross-section which on two confronting insides are provided with a row of contact elements 9 each and at the rear end thereof have a collar 82 extending around the contact support 8.

450 The contact elements 9 are arranged on the contact support 8 such that the front end thereof terminates a distance before the front end of the contact support 8 and that the rear end thereof, inclusive of the bent or kinked portion 81 projects beyond the rear end of the
455 contact support 8.

The part of the contact elements extending along the surface of contact support 8, in the embodiment illustrated, is connected to the contact support 8 along the
460 entire length thereof. The contact elements 9 thus can be reliably held in their proper position, even if they are of very small and/or weak design and even if they were subjected to mechanical loads.

465 A contact support 8 and the contact elements 9 arranged thereon as just described constitute a coupling module KM of the type shown in Fig. 1.

The contact support 8 is tapered on the inside edge on
470 its front end (where no contact elements are provided). This serves for centering the mutually associated plug and coupling modules when plug and coupling member are mated.

475 A plurality of the coupling modules KM that can be configured and made as described hereinbefore can be com-

bined with the afore-mentioned base 6 and the afore-mentioned housing 7 so as to form a coupling member of the type according to Fig. 3.

480

In the example shown, the base 6 is a plate-like member designed at the top thereof for placement of a plurality of coupling modules KM and of the housing 2, and designed at the bottom thereof for soldering the rear ends of the contact elements 9 to the base 6 and for mounting the base 6 on a circuit board, not shown in the drawings. The base 6 is formed in its bottom with a multiplicity of holes provided for passage of the rear ends of the contact elements 9. The top side of the base bottom is provided in addition with the recesses which, in the assembled state of the coupling member, constitute the already mentioned cavities 61. In assembling the coupling modules KM on the base 6, the rear ends of the contact elements 9 are passed through the holes in the base bottom and are soldered or otherwise electrically and/or mechanically connected to the base on the bottom side thereof or to elements provided for connecting the base to the circuit board. The bent or kinked portions 91 of the contact elements 9 thus come to lie in the recesses of the base that constitute the cavities 61 of the coupling member.

490

In the embodiment illustrated, the housing 7 is a profiled member of rectangular cross-section that is open at the top and at the bottom and has an inner portion subdivided by intermediate walls 72 extending parallel to the outer walls 71. By way of the outer and intermediate walls 71 and 72, a multiplicity of channels is defined that are arranged side by side and on top of each other, with each channel being adapted to receive a coupling module. The outer and ~~lateral~~ ^{intermediate} walls 71, 72 of housing 7 extend around each individual coupling module

505

510

when the coupling modules are in the state attached to the base and the ~~coupling modules~~ housing.

515

The outer and ~~lateral walls~~ ^{intermediate} 71 and 72 have projections 711 and 721 which project into the channels and, in the assembled state of the coupling member, come to lie shortly above the collars 82 of the coupling modules KM; 520 the collars 82 of the coupling modules, in the assembled state of the coupling member, come to lie between base 6 and housing 7, as shown in exemplary manner in Fig. 4B.

525

The housing 7 is connected to the base 6, for example, by an adhesive bond, a locking-type connection or other connection. Base 6, housing 7 and coupling modules KM thus are combined to form an integral unit.

530

In the assembled state of the coupling member, as described, the walls 71 and 72 of housing 7 extend around each individual one of the coupling modules of the coupling member. The housing parts (walls 71, 72) enclosing the coupling modules project beyond the front ends of the coupling modules.

535

The front end of outer walls 71 of housing 7 are provided with a taper 712 on the outsides thereof. This taper serves to center plug housing and coupling housing when plug and coupling member are being mated.

540

545

Upon mating of plug and coupling member, the front ends of housings 2 and 7 meet first, since at least one of the housings, but preferably both housings, extend beyond the front ends of plug and/or coupling modules. Due to the tapers 23 and 712 provided at the front ends of the housings, the housings are centered relative to each other and may thus easily be slid onto each other. In the embodiment illustrated, the plug housing is slid

over the coupling housing. When the housings 2 and 7
550 meet, the plug modules and the coupling modules still
are a distance apart from each other. Sliding of the
housings 2 and 7 onto each other thus may effect pre-
centering of the same - without any forces acting on the
plug modules and the coupling modules.

555 While the plug housing is being slid onto the coupling
housing, the associated plug and coupling modules sooner
or later meet. As these are tapered on their front ends
as well and since, moreover, they are already pre-cen-
560 tered, they can be inserted into each other substan-
tially without any mechanical loads being exerted
thereon.

In the embodiment illustrated, this is enhanced further
565 by the fact that the plug modules and/or the coupling
modules are movable relative to each other and/or rela-
tive to the respective housings and/or bases.

With regard to the plug modules, this movability is
570 achieved in that

- the plug modules are attached to the plug "only" in
that a predetermined part of the plug modules (the
collar 32 in the embodiment illustrated) is held more
575 or less loosely between base 1 and housing 2 (between
collar 32 and the parts of base 1 and housing 2 sur-
rounding the same, there are provided spaces permit-
ting movements of the respective plug module to a
certain extent in the assembled state of the plug as
580 well), and
- the contact elements 4 have a bent or kinked portion
(portion 41) which comes to lie in a cavity (cavity
11) provided between base 1 and housing 2 and thus to
585 a certain extent permits relative movements of the

contact element parts located on either side of portion 41 in the assembled state of the plug as well.

590 The plug modules thus can at least slightly move relative to each other and/or relative to the other plug components.

With respect to the coupling modules that are movable in this manner as well, the movability is achieved in that

595 - the coupling modules are attached to the coupling member "only" in that a predetermined part of the coupling modules (the collar 82 in the embodiment illustrated) is held more or less loosely between base 61 and housing 72 (between collar 82 and the parts of
600 base 6 and housing 7 surrounding the same, there are provided spaces permitting movements of the respective coupling module to a certain extent in the assembled state of the plug as well), and

605 - the contact elements 9 have a bent or kinked portion (portion 91) which comes to lie in a cavity (cavity 61) provided between base 6 and housing 7 and thus to a certain extent permits relative movements of the
610 contact element parts located on either side of portion 91 in the assembled state of the coupling member as well.

615 The coupling modules thus can at least slightly move relative to each other and/or relative to the other coupling member components.

620 Due to the mutually independent floating arrangement of the plug modules SM within the plug and the mutually independent floating arrangement of the coupling modules KM in the coupling member, the plug modules and the cou-

pling modules can align optimally with respect to each other in all situations, whereby they can at all times be properly mated automatically and without or at any rate without significant mechanical loads being exerted on the modules and the connectors containing the same. This holds even if the components of the plugs and coupling members are not manufactured and/or assembled exactly according to specifications and/or if their positions and/or their dimensions vary (e.g. due to slight damages or temperature fluctuations).

In mating plug and coupling member, each plug contact element 4 establishes contact with the associated coupling member contact element 9 at multiple locations. It is thus possible to establish electrical connections of highest quality.

The coupling member contact elements 9, during mating with the plug contact elements 4, come to lie in the groove-like recesses 31 of the plug modules; the webs of the contact support 3 of the plug, which are present between adjacent groove-like recesses 31, in the mated state of plug and coupling member, extend up to the contact supports 8 of the coupling member and thus separate (isolate) adjacent contact element pairs from each other. Adjacent contact elements of the plug and coupling modules thus cannot interfere with each other. In particular, no flow of leakage currents is possible.

Plugs and coupling members with constructions as described can be mated and unmated substantially without a risk of damage and, in doing so, permit excellent electrical connections to be established in all situations. The connections are of low impedance, withstand high voltages and large currents and are relatively insensitive to fluctuating or adverse effects from the sur-

roundings, such as extreme and/or fluctuating temperatures, vibrations, moisture, dirt etc.

660

The properties mentioned are obtained irrespective of the size and contact density of the electrical connectors designed and manufactured as described hereinbefore.

665

The electrical connectors described thus can be made very small and/or with high contact density with in essence the same excellent properties.

670

This was confirmed by tests: to this end, the electrical connectors shown in Figs. 2 and 8, i.e. electrical connectors each with 8 connector modules and in total 256 contacts were realized on a space of 24.9 mm x 5.4 mm x 9 mm (length x width x depth in the mated state).

675

The handling properties of the electrical connectors and the quality of the electrical connections that can be produced by them turned out to be excellent.

680

Some technical data:

Range of operating temperatures:

-30 to +125°C

685

Current-carrying capacity per contact:

250 mA at 25°C

150 mA at 85°C

Breakdown strength of adjacent contacts:

690

650 V with dc current

750 V with ac current

Volume resistivity:

175 mΩ

695

Contact resistance:

40 m Ω

Insulation resistance:

700

4 x 10¹⁰ Ω

These are results that cannot even approximately be achieved using known multi-position miniature connectors.

705

For connecting the electrical connectors to the circuit board carrying them, it is to be pointed out that the electrical connectors, to be more precise the bases thereof, can be mounted on circuit boards using, for example, the so-called BGA (ball grid array) or PSGA (plastic stud grid array) technology.

715

With regard to BGA technology, it is to be pointed out that the balls may be arranged directly at the locations where the contact element parts passed through the base reach the bottom side of the base, or may be arranged more or less remote therefrom.

720

In the latter case, i.e. if the balls are arranged more or less remote from the locations where the contact element parts passed through the base reach the bottom side of the base, the contact elements or the locations where these reach the bottom side of the base, respectively, and the balls must be electrically connected to each other via conductive tracks or in a different manner. This is illustrated in Fig. 5 in exemplary manner. The locations where the contact elements reach the bottom side of the base are designated 15, the balls are designated 16 and the conductive tracks connecting the locations 15 to the balls 16 are designated 17.

730

If the balls are arranged directly at the locations where the contact elements reach the bottom side of the base, these locations are preferably positioned such that they (and the balls to be applied thereto) are spaced apart by certain minimum distances. The locations where the contact elements reach the base bottom side then are no longer arranged in two opposing rows, as in case of the contact elements on the contact supports, but are arranged, for example, in two opposing double rows each consisting of two individual rows arranged in mutually offset manner (in the embodiment illustrated, by half of the distance between adjacent elements of the row). Such an arrangement is shown in Fig. 6. The locations where the contact elements reach the base bottom side are again designated 15, and the balls are again designated 16. The balls 16 lie on the locations 15 so that, contrary to the base according to Fig. 5, there are no longer required conductive tracks for connecting the same.

Due to the measures mentioned, it is possible in both cases, i.e. both if the balls are arranged directly at the locations where the contact element parts passed through the base reach the base bottom side, and if the balls are more or less remote from these locations, to ensure in all situations (in particular irrespective of the contact element density of the respective connector modules) that the balls are spaced apart from each other to the extent necessary for practical application of the BGA technology.

Irrespective of this, plugs and coupling members of the type described hereinbefore may also be realized with leading or trailing contacts, double contacts and power contacts.

Electrical connectors having a construction as described
may be designed as multi-position miniature connectors
770 by means of which electrical connections of high quality
can be established in reliable manner.

("ANNEXES" of IPER)

Translation of Amended Pages 21 to 26

5 **Claims**

1. An electrical connector comprising a multiplicity of contact elements (4; 9),
with the electrical connector containing one or
10 more connector modules (SM; KM), each thereof comprising at least one contact support (3; 8) and a multiplicity of contact elements (4; 9) connected to the contact support and extending along the surface thereof,
15 characterized in that the contact supports (3; 8) and the contact elements (4; 9) supported by the same are connected to each other in non-releasable manner.
- 20 2. An electrical connector according to claim 1, characterized in that the contact elements (4; 9) are constituted by metal strips.
3. An electrical connector according to claim 1 or 2,
25 characterized in that the front ends of the contact supports (3; 8) are portions thereof without contact elements.
4. An electrical connector according to any of the preceding claims,
30 characterized in that the front ends of the contact supports (3; 8) are provided with tapers suitable for centering with respect to other contact elements (3; 8).

35

5. An electrical connector according to any of the preceding claims,
characterized in that the contact elements (4; 9)
project beyond the rear end of the contact supports
40 (3; 8).
6. An electrical connector according to claim 5,
characterized in that the contact elements (4; 9)
have a bent or kinked section (41; 91) in the portion
45 thereof extending beyond the rear end of the contact supports (3; 8).
7. An electrical connector according to claim 6,
characterized in that the bent or kinked sections
50 (41; 91) of the contact elements (4; 9), in the assembled state of the electrical connector, come to lie in a cavity (11; 61) contained in said connector.
- 55 8. An electrical connector according to claim 6 or 7,
characterized in that the contact element parts located on either side of the bent or kinked sections (41; 91) are movable relative to each other also in the assembled state of the electrical connector.
- 60 9. An electrical connector according to any of the preceding claims,
characterized in that the contact elements (4; 9),
in the region in which they are supposed to establish
65 contact with an associated contact element (4; 9), have one or more protuberances or bulges (42) acting as contact locations.
10. An electrical connector according to claim 9,

70 characterized in that the portions of the contact
elements (4; 9) having said protuberances or bulges
(42) are designed to be resilient.

11. An electrical connector according to any of the pre-
ceding claims,
75 characterized in that the contact elements (4; 9)
are connected to the contact supports (3; 8) by hav-
ing plastics material injection-molded around part
thereof.

80 12. An electrical connector according to any of the pre-
ceding claims,
characterized in that the contact supports (3; 8)
have groove-like recesses (31) at those locations
85 where contact elements (4; 9) are to be provided
thereon.

13. An electrical connector according to claim 12,
characterized in that the contact elements (4; 9)
90 are inserted into the groove-like recesses (31) of
the contact supports (3; 8) and, at the rear end of
the contact supports, are connected to the contact
support in that plastics material is injection-
molded thereto.

95 14. An electrical connector according to claim 12 or 13,
characterized in that the contact elements (4; 9)
are designed and mounted to the contact supports (3;
8) such that the parts thereof extending through the
100 groove-like recesses, which are not injection-molded
to the contact supports, are resiliently urged
against the bottom of the groove-like recess through
which they extend.

- 105 15. An electrical connector according to any of claims 1
to 12,
characterized in that the contact support (3; 8) is
injection-molded to the contact elements (4; 9).
- 110 16. An electrical connector according to any of the pre-
ceding claims,
characterized in that, in the assembled state of the
electrical connector, a predetermined section (32;
82) of the connector modules (SM; KM) is inserted
115 between other components (1, 2; 6, 7) of the elec-
trical connector and thereby is held there.
17. An electrical connector according to claim 16,
characterized in that said predetermined section
120 (32; 82) of the connector modules (SM; KM) and the
other components (1, 2; 6, 7) of the electrical con-
nector receiving said section therebetween have
spaces provided therebetween.
- 125 18. An electrical connector according to any of the pre-
ceding claims,
characterized in that the connector modules (SM;
KM), in the assembled state of the electrical con-
nector, are movable relative to each other and/or
130 relative to other components (1, 2; 6, 7) of the
electrical connector.
19. An electrical connector according to any of the pre-
ceding claims,
135 characterized in that the connector modules (SM; KM)
are individually or commonly enclosed on the sides
thereof by parts of a housing (2; 7).
20. An electrical connector according to claim 19,

- 140 characterized in that the housing parts enclosing
the connector modules (SM; KM) project beyond the
front end of the connector modules.
21. An electrical connector according to claim 20,
145 characterized in that the housing parts projecting
beyond the front end of the connector modules (SM;
KM) are provided with tapers (23; 712) suitable for
centering with respect to the housings of other
electrical connectors.
- 150 22. An electrical connector according to any of the pre-
ceding claims,
characterized in that, in mating the electrical con-
nector with a complementary, second electrical con-
155 nector, the connector modules (SM; KM) meet each
other only after having been pre-centered.
23. An electrical connector according to claim 22,
characterized in that the pre-centering is effected
160 by centering of housing parts meeting each other
therebefore.
24. An electrical connector according to any of the pre-
ceding claims,
165 characterized in that said connector is designed to
be soldered to a circuit board using the PSGA tech-
nology.
25. An electrical connector according to any of claims 1
170 to 23,
characterized in that said connector is designed to
be soldered to a circuit board using the BGA tech-
nology.
- 175 26. An electrical connector according to claim 25,

characterized in that the balls (16) are arranged remote from the locations (15) where the contact elements (4; 9) reach the section (1; 6) of the electrical connector to be soldered to the circuit board, and that the respective locations and the associated balls are connected to each other via conductive tracks (17).

27. An electrical connector according to claim 25, characterized in that the balls (16) are arranged at the locations (16) where the contact elements (4; 9) reach the section of the electrical connector to be soldered to the circuit board, and in that the arrangement of the respective locations is selected to be different from the arrangement of the contact elements on the contact supports (3; 8).

(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES
PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

(19) Weltorganisation für geistiges Eigentum
Internationales Büro



(43) Internationales Veröffentlichungsdatum
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13/26, 13/631

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18. August 2000 (18.08.2000)

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(81) Bestimmungsstaaten (national): BR, CA, JP, KR, US.

(84) Bestimmungsstaaten (regional): europäisches Patent (AT,
BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC,
NL, PT, SE).

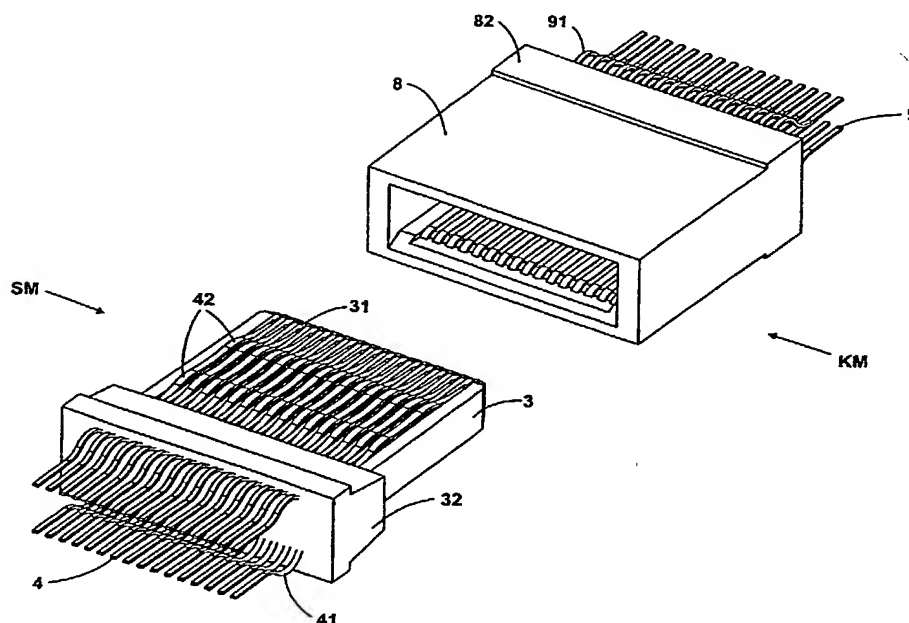
Veröffentlicht:

— Mit internationalem Recherchenbericht.

[Fortsetzung auf der nächsten Seite]

(54) Title: ELECTRICAL CONNECTOR

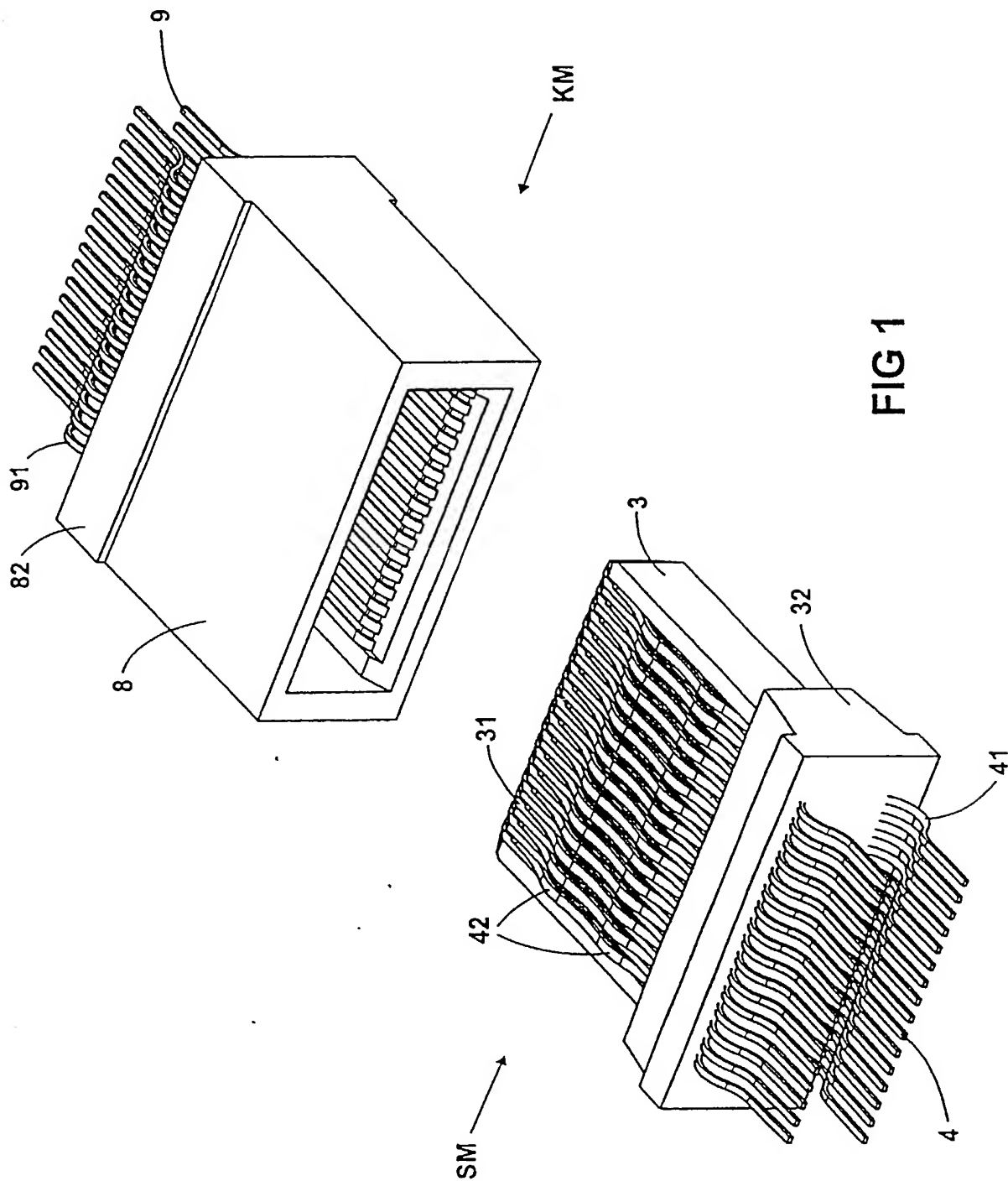
(54) Bezeichnung: ELEKTRISCHER STECKVERBINDER



(57) Abstract: The invention relates to an electrical connector that contains one or more connector modules each of which comprises at least one contact support and a plurality of contact elements that are connected to said contact support and that extend along its surface. Such an electrical contact can be configured as a multi-pole miniaturized electrical connector with which high-quality electrical connections can be reliably established.

[Fortsetzung auf der nächsten Seite]

WO 01/15280 A1



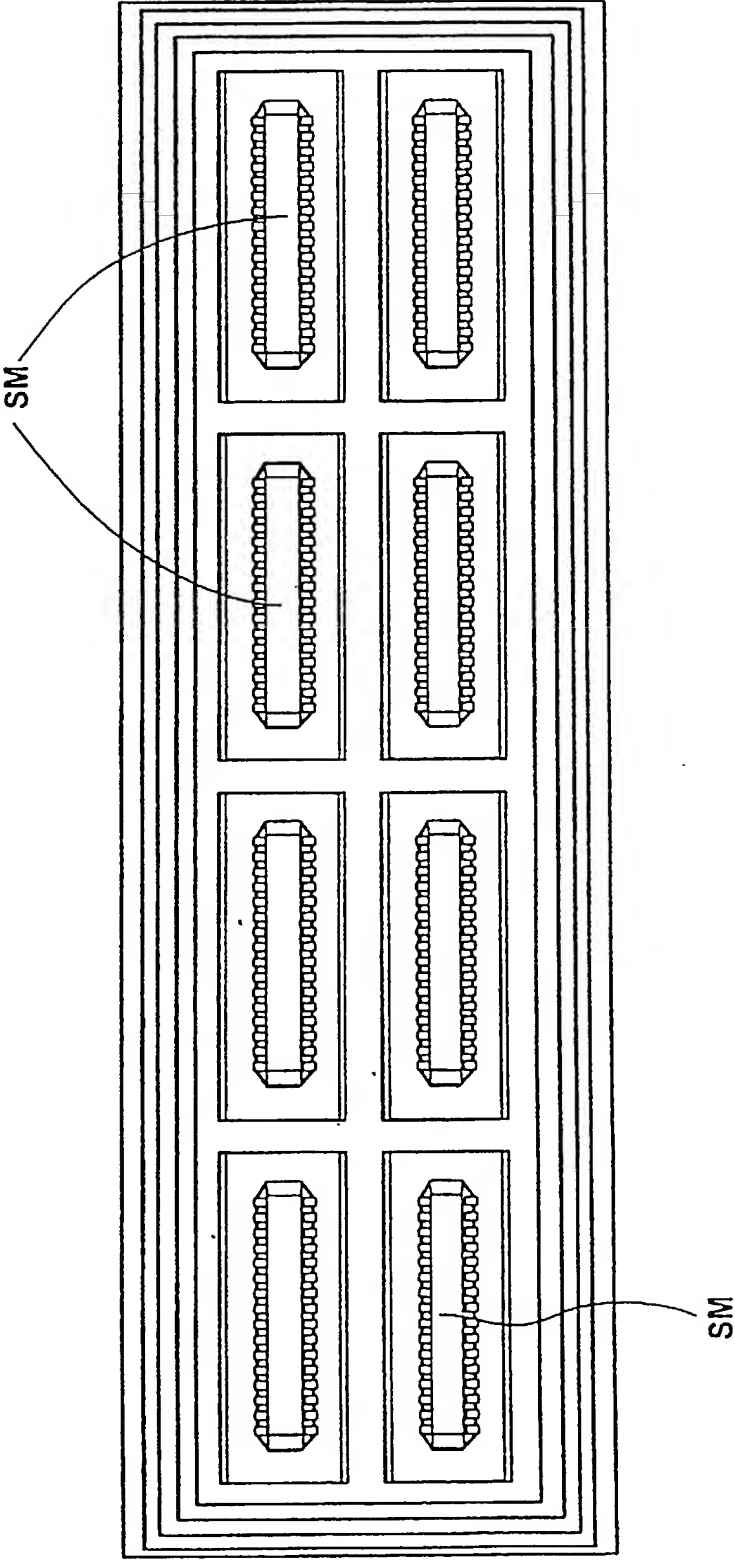


FIG 2

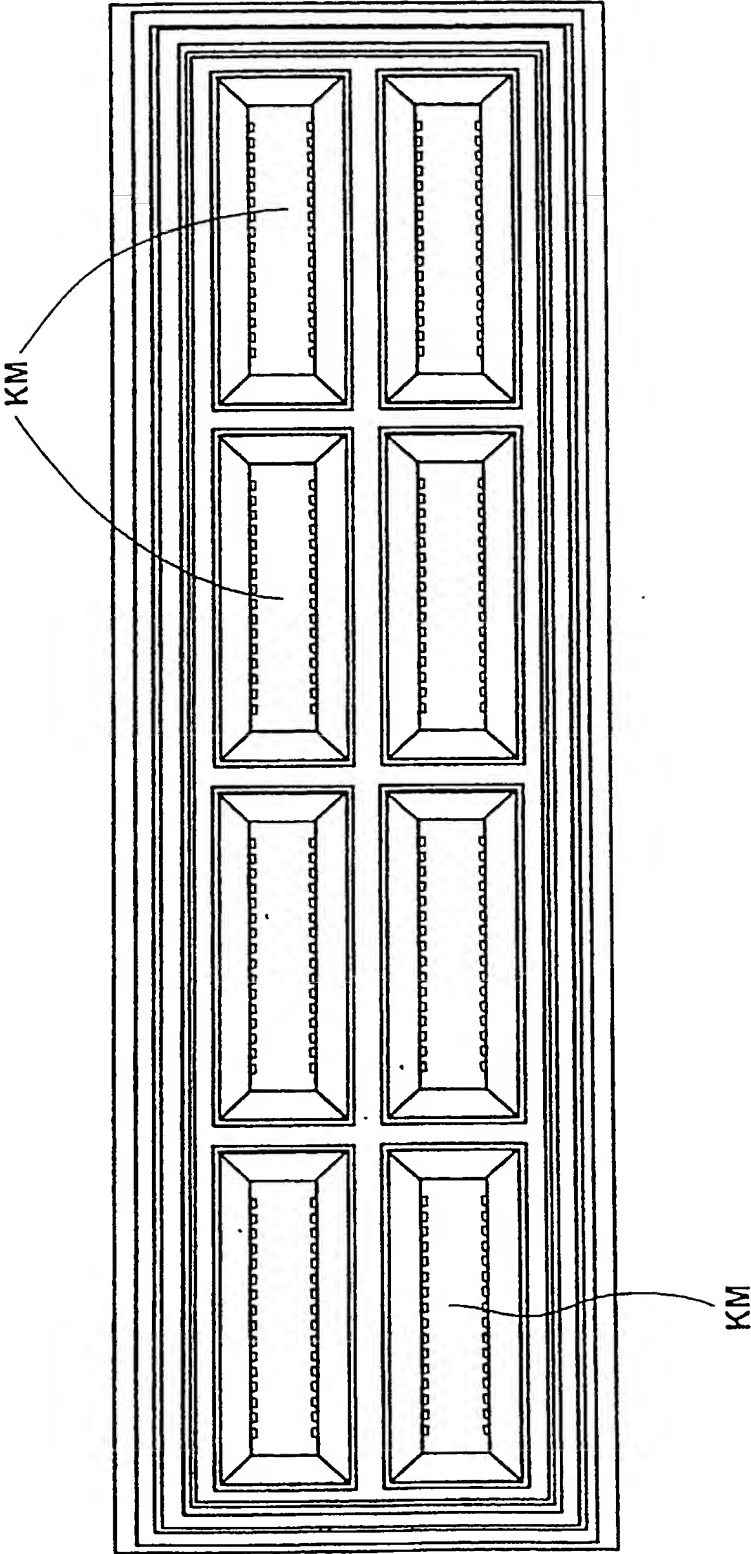


FIG 3

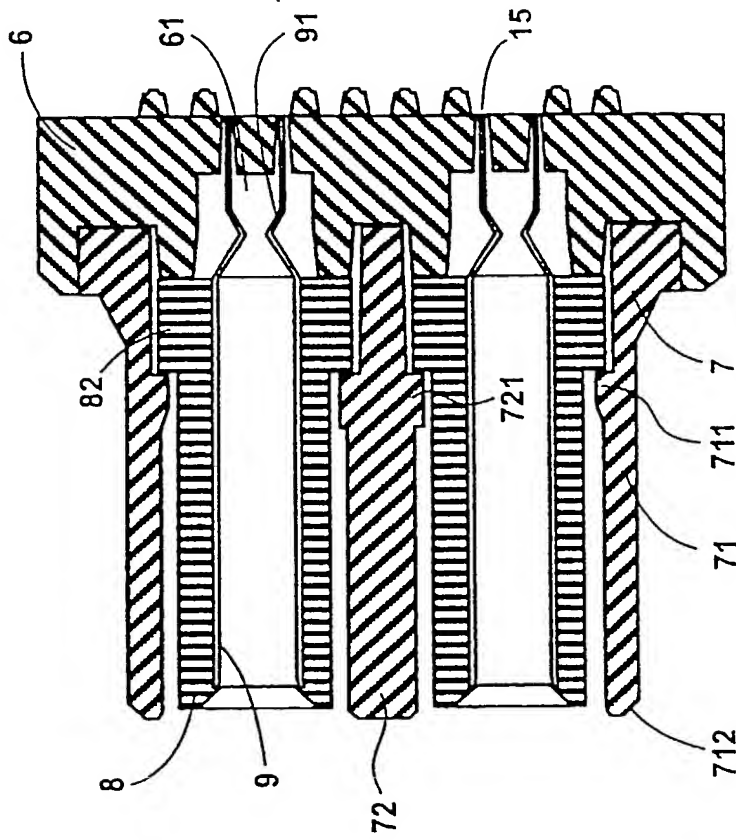


FIG 4B

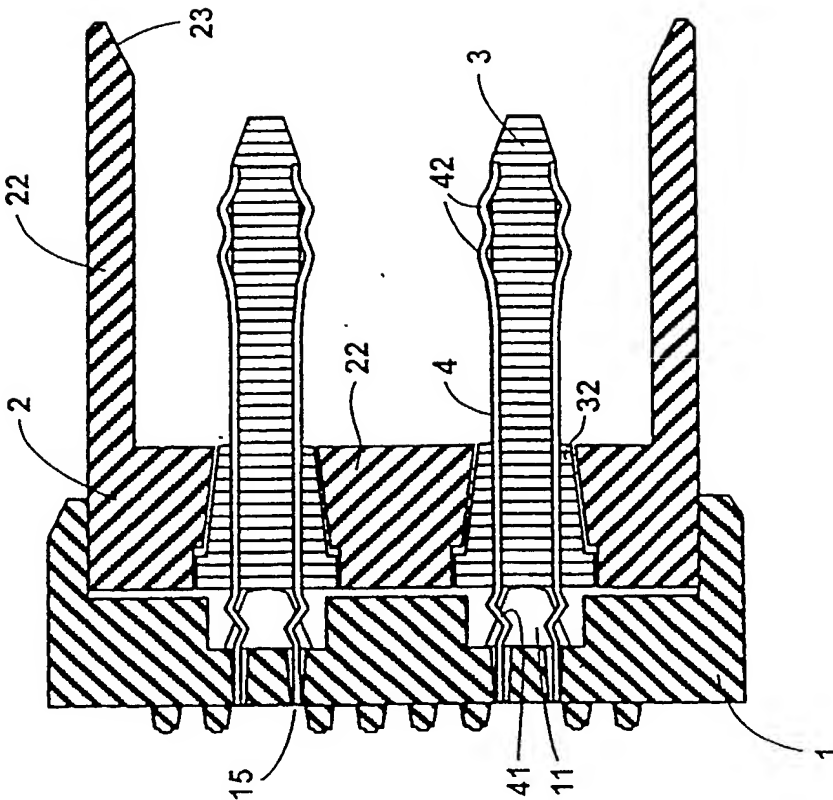


FIG 4A

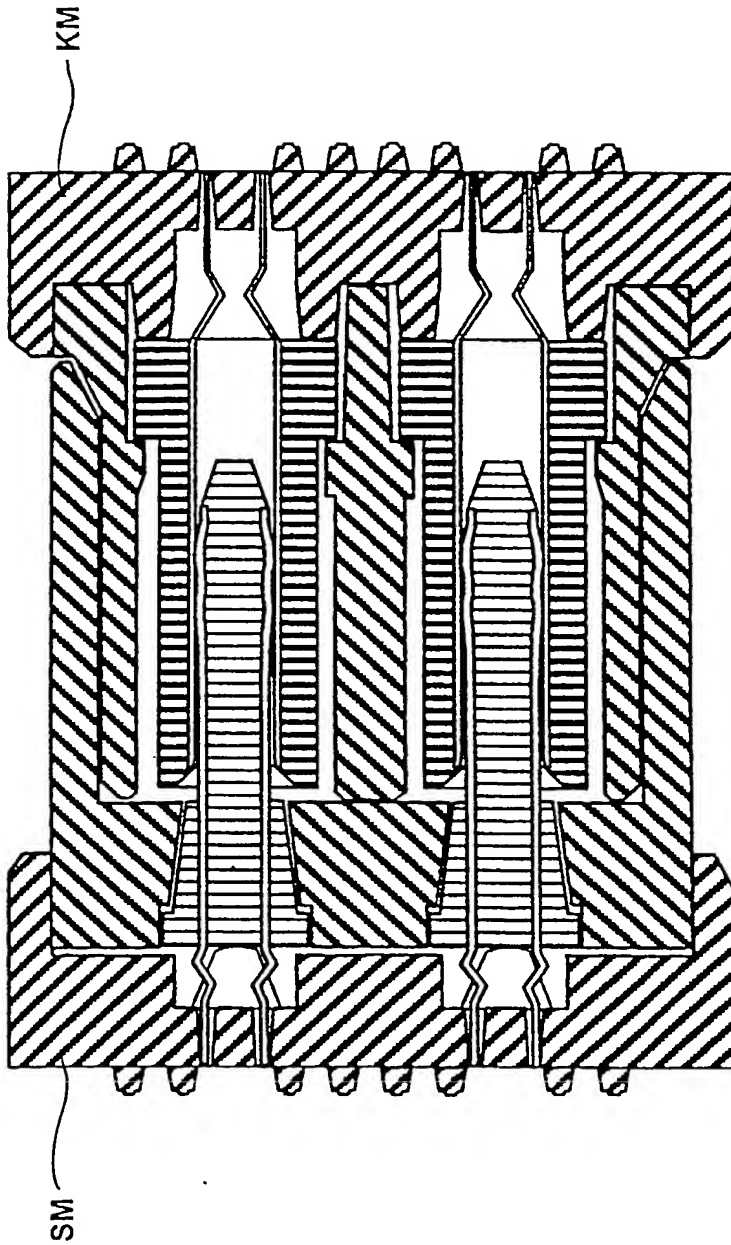


FIG 4C

FIG 5

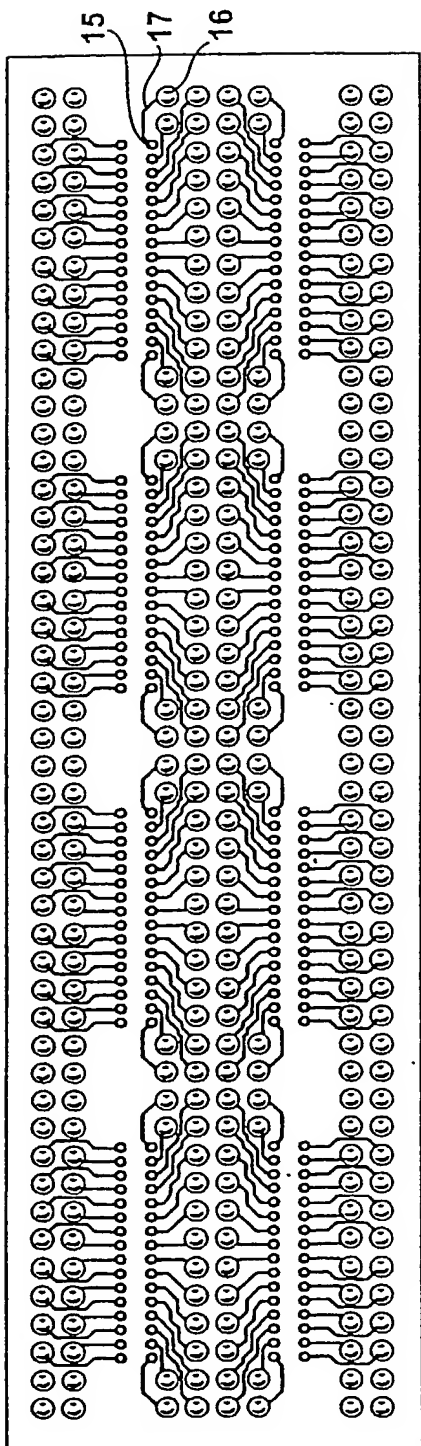
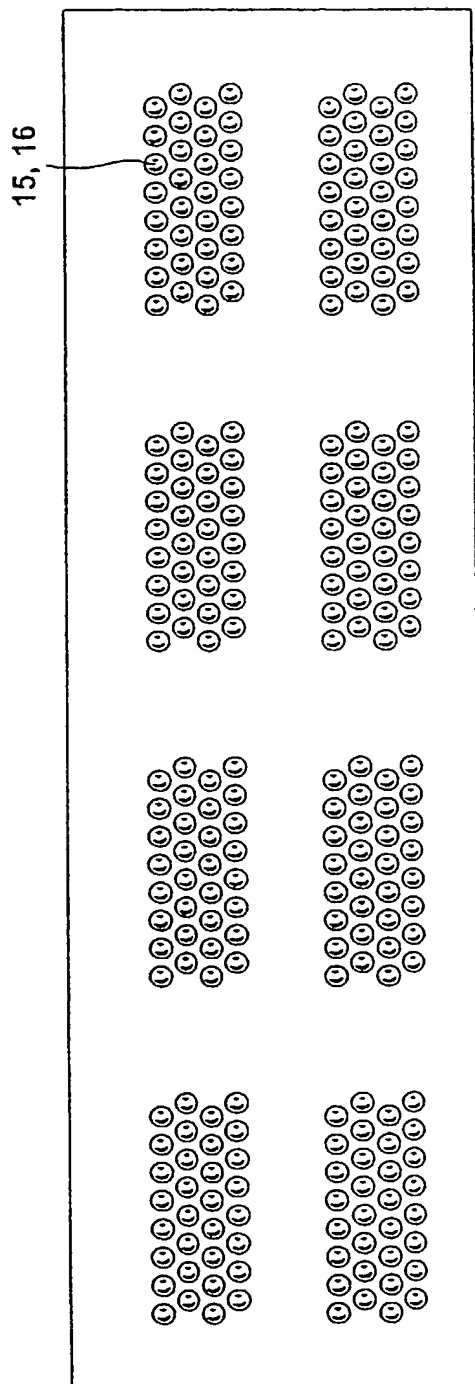


FIG 6



Docket No.
KSN0024

Declaration and Power of Attorney For Patent Application

English Language Declaration



As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

ELECTRICAL CONNECTOR

the specification of which

(check one)

☐ is attached hereto.

☒ was filed on February 19, 2002 as United States Application No. or PCT International Application Number 10/049,950 and was amended on February 19, 2002

(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)			Priority Not Claimed
<u>DE 19939580.2</u>	<u>Germany</u>	<u>20 August 1999</u>	<input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	
<u></u>	<u></u>	<u></u>	<input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	
<u></u>	<u></u>	<u></u>	<input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	

I hereby claim the benefit under 35 U.S.C. Section 119(e) of any United States provisional application(s) listed below:

(Application Serial No.)

(Filing Date)

(Application Serial No.)

(Filing Date)

(Application Serial No.)

(Filing Date)

I hereby claim the benefit under 35 U. S. C. Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. Section 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, C. F. R., Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

PCT/DE00/02842

18 August 2000

Pending

(Application Serial No.)

(Filing Date)

(Status)
(patented, pending, abandoned)

(Application Serial No.)

(Filing Date)

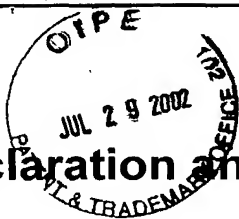
(Status)
(patented, pending, abandoned)

(Application Serial No.)

(Filing Date)

(Status)
(patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.



Docket No.
KSN0024

Declaration and Power of Attorney For Patent Application

English Language Declaration

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

ELECTRICAL CONNECTOR

the specification of which

(check one)

☐ is attached hereto.

☒ was filed on February 19, 2002 as United States Application No. or PCT International Application Number 10/049,950

and was amended on February 19, 2002

(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

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Prior Foreign Application(s)

Priority Not Claimed

DE 19939580.2
(Number)

Germany
(Country)

20 August 1999
(Day/Month/Year Filed)

☐

(Number)

(Country)

(Day/Month/Year Filed)

☐

(Number)

(Country)

(Day/Month/Year Filed)

☐

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(Application Serial No.)

(Filing Date)

(Application Serial No.)

(Filing Date)

(Application Serial No.)

(Filing Date)

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PCT/DE00/02842

18August 2000

Pending

(Application Serial No.)

(Filing Date)

(Status)
(patented, pending, abandoned)

(Application Serial No.)

(Filing Date)

(Status)
(patented, pending, abandoned)

(Application Serial No.)

(Filing Date)

(Status)
(patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

Eric J. Groen, ~~32,230~~
 Gerard T. Gallagher, ~~39,679~~
 Daniel Tychonievich, ~~41,358~~
 Kevin R. Erdman, ~~33,687~~
 Michael S. Gzybowski, ~~32,816~~
 John F. Hoffman, ~~26,280~~ ⑨
 Anthony Niewyk, ~~24,871~~
 Nancy G. Tinsley, ~~37,098~~
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POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

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